

**AMENDMENTS TO THE CLAIMS**

1. (Currently Amended) A computer-assisted 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

recording images of surroundings of the endoscope unit;

transmitting image data of the recorded images, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device;

executing a pattern recognition algorithm for identifying substantially corresponding features of successive individual images of a recorded image sequence;  
and

carrying out an image processing procedure for the concatenation of individual images by superimposing the identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit;

calculating distance squares ( $d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj})$ ) between the image parameters, stored in the form of  $N$ -dimensional feature vectors ( $\underline{x}_{Mi}$ ), of recorded individual images with the image parameters, stored in the form of  $N$ -dimensional reference vectors ( $\underline{x}_{Rj}$ ), of images of diseased tissue structures from a reference image database by calculating the square of the Euclidean length ( $\|\Delta \underline{x}_{ij}\|_2$ ) of their difference vectors ( $\Delta \underline{x}_{ij} := \underline{x}_{Mi} - \underline{x}_{Rj}$ ); and

determining the reference vectors ( $x_{Rj}$ ) of the reference images whose distance squares ( $d_{ij}^2$ ) are a minimum in relation to the respective feature vectors ( $x_{Mi}$ ) of the individual images to be examined.

2. (Original) The computer-assisted 3D imaging method as claimed in claim 1, wherein, with each  $i$ -th recording, the position of the endoscope unit is detected and transmitted together with the image data to the reception and evaluation device and is digitally stored therein,  $i$  being a whole number greater than or equal to one.
3. (Original) The computer-assisted 3D imaging method as claimed in claim 1, wherein at least one of the position and orientation of the capsule-type endoscope unit is detected and inserted into the pseudo three-dimensional representation visualized via a display device.
4. (Original) The computer-assisted 3D imaging method as claimed in claim 1, wherein different camera perspectives of the surroundings of the endoscope unit are displayed by navigating a cursor in a control window of an operator interface, represented on a display device, of a computer program.
5. (Original) The computer-assisted 3D imaging method as claimed in claim 4, wherein the navigation is performed by way of input parameters.
6. (Canceled)

7. (Original) The computer-assisted 3D imaging method as claimed in claim 1, wherein the pseudo three-dimensional representation of the surroundings of the endoscope unit visualized via a display device, is inspectable in the course of a virtual endoscopy by varying the viewing perspective with the aid of control signals of an input unit.

8. (Original) The computer-assisted 3D imaging method as claimed in claim 1, wherein, for concatenation of two individual images ( $m, n$ ), use is made of the path difference ( $\Delta x_{m,n} := x_n - x_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ( $x_m, x_n$ ) of the unit for recording the two individual images ( $m, n$ ).

9. (Original) The computer-assisted 3D imaging method as claimed in claim 8, wherein instantaneous recording positions ( $x_m, x_n$ ) of the capsule-type endoscope unit are determined by evaluating X-ray pictures in which the endoscope unit is identifiable.

10. (Original) The computer-assisted 3D imaging method as claimed in claim 8, wherein instantaneous recording positions ( $x_m, x_n$ ) of the capsule-type endoscope unit are determined by evaluating the signal transit times ( $T_m, T_n$ ) of the wireless image data transmission from the endoscope unit to the reception device.

11. (Currently Amended) A wireless endoscope unit in the form of a swallowable capsule, comprising

an integrated camera for recording a sequence of individual images;

a transmitter for wireless transmission of image data of the recorded images to a reception device and evaluation device; and

a permanent magnet, provided in the capsule, via which the endoscope unit is actively movable in a wireless fashion upon application of a temporally varying external magnetic field, wherein

with each  $i$ -th recording, the position of the endoscope unit is detected and transmitted together with the image data to the reception device and evaluation device and is digitally stored therein,  $i$  being a whole number greater than or equal to one, and

the evaluation device is configured to carry out an image processing procedure for concatenation of individual images, wherein the concatenation of two individual images ( $m, n$ ), includes using the path difference ( $\Delta x_{m,n} := x_n - x_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ( $x_m, x_n$ ) of the unit for recording the two individual images ( $m, n$ ).

12. (Currently Amended) A medical apparatus for recording and evaluating signals from a capsule-type endoscope unit, comprising:

a reception unit for wireless reception of image information transmitted by the capsule-type endoscope unit;

a computation unit for decoding the image data transmitted by the capsule-type endoscope unit and for carrying out an image conditioning process for producing a pseudo three-dimensional representation of received image information; and

a display device for visualizing the conditioned image data, wherein

the computation unit is configured to calculate distance squares

$(d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj}))$  between the image parameters, stored in the form of  $N$ -

dimensional feature vectors  $(\underline{x}_{Mi})$ , of recorded individual images with the image

parameters, stored in the form of  $N$ -dimensional reference vectors  $(\underline{x}_{Rj})$ , of images of

diseased tissue structures from a reference image database by calculating the square of

the Euclidean length  $(\|\Delta \underline{x}_{ij}\|_2)$  of their difference vectors  $(\Delta \underline{x}_{ij} := \underline{x}_{Mi} - \underline{x}_{Rj})$  and

determine the reference vectors  $(\underline{x}_{Rj})$  of the reference images whose distance squares

$(d_{ij}^2)$  are a minimum in relation to the respective feature vectors  $(\underline{x}_{Mi})$  of the individual

images to be examined.

13. (Original) The medical apparatus as claimed in claim 12, further comprising a magnet tube, including field coils for generating a stationary homogeneous magnetic field  $(\vec{B}_0)$ , and one gradient coil, each with an associated gradient amplifier for three Cartesian space coordinates  $x$ ,  $y$  and  $z$  for locally changing the magnetic field in the  $\pm x$ -,  $\pm y$ - and/or  $\pm z$ - directions.

14. (Original) The medical apparatus as claimed in claim 12, further comprising:

a distributed arrangement of metal sensors for locating metal parts of the capsule-type endoscope unit; and

a measuring sensor, connected to the sensor arrangement, including a transponder as an interface between the sensor arrangement and the computation unit.

15. (Original) The computer-assisted 3D imaging method as claimed in claim 2, wherein at least one of the position and orientation of the capsule-type endoscope unit is detected and inserted into the pseudo three-dimensional representation visualized via a display device.

16. (Original) The computer-assisted 3D imaging method as claimed in claim 4, wherein the navigation is performed by way of input parameters including magnitude of an advancing movement in a direction of movement of the capsule-type endoscope unit, and magnitude of rotary movement about an axis pointing in the direction of movement.

17. (Canceled)

18. (Original) The computer-assisted 3D imaging method as claimed in claim 3, wherein the pseudo three-dimensional representation of the surroundings of the endoscope unit visualized via the display device, is inspectable in the course of a virtual endoscopy by varying the viewing perspective with the aid of control signals of an input unit.

19. (Original) The computer-assisted 3D imaging method as claimed in claim 4, wherein the pseudo three-dimensional representation of the surroundings of the endoscope unit visualized via the display device, is inspectable in the course of a virtual endoscopy by varying the viewing perspective with the aid of control signals of an input unit.

20. (Currently Amended) The computer-assisted 3D imaging method as claimed in claim 1[[6]], wherein, for concatenation of two individual images ( $m, n$ ), use is made of the path difference ( $\Delta \underline{x}_{m,n} := \underline{x}_n - \underline{x}_m$ ), covered by the capsule-type endoscope unit and loaded with a

weighting factor, between the instantaneous recording positions ( $\underline{x}_m, \underline{x}_n$ ) of the unit for recording the two individual images ( $m, n$ ).

21. (Original) The computer-assisted 3D imaging method as claimed in claim 2, wherein, for concatenation of two individual images ( $m, n$ ), use is made of the path difference ( $\Delta \underline{x}_{m,n} := \underline{x}_n - \underline{x}_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ( $\underline{x}_m, \underline{x}_n$ ) of the unit for recording the two individual images ( $m, n$ ).

22. (Currently Amended) The computer-assisted 3D imaging method as claimed in claim 21, wherein the instantaneous recording positions ( $\underline{x}_m, \underline{x}_n$ ) of the capsule-type endoscope unit are determined by evaluating X-ray pictures in which the endoscope unit is ~~identifiable~~ identifiable.

23. (Original) The computer-assisted 3D imaging method as claimed in claim 21, wherein the instantaneous recording positions ( $\underline{x}_m, \underline{x}_n$ ) of the capsule-type endoscope unit are determined by evaluating the signal transit times ( $T_m, T_n$ ) of the wireless image data transmission from the endoscope unit to the reception device.

24. (Original) The medical apparatus as claimed in claim 13, further comprising:

a distributed arrangement of metal sensors for locating metal parts of the capsule-type endoscope unit; and

a measuring sensor, connected to the sensor arrangement, including a transponder as an interface between the sensor arrangement and the computation unit.

25. (Currently Amended) A 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

identifying substantially corresponding features of successive individual images of a recorded sequence of images of surroundings of the endoscope unit; ~~and~~

concatenating individual images by superimposing identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit;

calculating distance squares  $(d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj}) )$  between the image parameters, stored in the form of  $N$ -dimensional feature vectors  $(\underline{x}_{Mi})$ , of recorded individual images with the image parameters, stored in the form of  $N$ -dimensional reference vectors  $(\underline{x}_{Rj})$ , of images of diseased tissue structures from a reference image database by calculating the square of the Euclidean length  $(\|\Delta \underline{x}_{ij}\|_2)$  of their difference vectors  $(\Delta \underline{x}_{ij} := \underline{x}_{Mi} - \underline{x}_{Rj})$ ; and  
determining the reference vectors  $(\underline{x}_{Rj})$  of the reference images whose distance squares  $(d_{ij}^2)$  are a minimum in relation to the respective feature vectors  $(\underline{x}_{Mi})$  of the individual images to be examined.

26. (Original) The method of claim 25, wherein image data of the recorded images are transmitted, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device



27. (Original) The method of claim 25, wherein a pattern recognition algorithm is executed to identify the substantially corresponding features of successive individual images.

28. (Currently Amended) A wireless endoscope unit in the form of a swallowable capsule, comprising

a video camera for recording a sequence of individual images;

a transmitter for wireless transmission of image data of the recorded images; and

a permanent magnet, provided in the capsule, via which the endoscope unit is actively movable in a wireless fashion upon application of a temporally varying external magnetic field, wherein

with each  $i$ -th recording, the position of the endoscope unit is detected and transmitted together with the image data to a reception and evaluation device and is digitally stored therein,  $i$  being a whole number greater than or equal to one, and

the evaluation device is configured to carry out an image processing procedure for concatenation of individual images, wherein the concatenation of two individual images ( $m, n$ ), includes using the path difference ( $\Delta x_{m,n} := x_n - x_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ( $x_m, x_n$ ) of the unit for recording the two individual images ( $m, n$ ).

29. (Currently Amended) A 3D imaging system for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

means for identifying substantially corresponding features of successive individual images of a recorded sequence of images of surroundings of the endoscope unit; and

means for concatenating individual images by superimposing identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit;

means for calculating distance squares ( $d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj})$ ) between the image parameters, stored in the form of  $N$ -dimensional feature vectors ( $\underline{x}_{Mi}$ ), of recorded individual images with the image parameters, stored in the form of  $N$ -dimensional reference vectors ( $\underline{x}_{Rj}$ ), of images of diseased tissue structures from a reference image database by calculating the square of the Euclidean length ( $\|\Delta \underline{x}_{ij}\|_2$ ) of their difference vectors ( $\Delta \underline{x}_{ij} := \underline{x}_{Mi} - \underline{x}_{Rj}$ ); and  
means for determining the reference vectors ( $\underline{x}_{Rj}$ ) of the reference images whose distance squares ( $d_{ij}^2$ ) are a minimum in relation to the respective feature vectors ( $\underline{x}_{Mi}$ ) of the individual images to be examined.

30. (Currently Amended) A medical apparatus for recording and evaluating signals from a capsule-type endoscope unit, comprising:

means for wireless reception of image information transmitted by the capsule-type endoscope unit;

means for carrying out an image conditioning process for producing a pseudo three-dimensional representation of the received image data; ~~and~~

means for calculating distance squares ( $d_{ij}^2 := d^2(\underline{x}_{Mi}, \underline{x}_{Rj})$ ) between the image parameters, stored in the form of  $N$ -dimensional feature vectors ( $\underline{x}_{Mi}$ ), of recorded

individual images with the image parameters, stored in the form of  $N$ -dimensional reference vectors  $(x_{Rj})$ , of images of diseased tissue structures from a reference image database by calculating the square of the Euclidean length  $(\|\Delta x_{ij}\|_2)$  of their difference vectors  $(\Delta x_{ij} := x_{Mi} - x_{Rj})$ ; and

means for determining the reference vectors  $(x_{Rj})$  of the reference images whose distance squares  $(d_{ij}^2)$  are a minimum in relation to the respective feature vectors  $(x_{Mi})$  of the individual images to be examined; and

means for displaying the conditioned image data.

31. (Currently Amended) A wireless endoscope unit in the form of a swallowable capsule, comprising

means for recording a sequence of individual images;

means for wireless transmission of image data of the recorded images; and

means, provided in the capsule, for actively moving the endoscope unit in a wireless fashion upon application of a temporally varying external magnetic field, wherein

with each  $i$ -th recording, the position of the endoscope unit is detected and transmitted together with the image data to a means for reception and evaluation and is digitally stored therein,  $i$  being a whole number greater than or equal to one, and

the means for reception and evaluation is for carrying out an image processing procedure for concatenation of individual images, wherein the concatenation of two individual images  $(m, n)$ , includes using the path difference  $(\Delta x_{m,n} := x_n - x_m)$ , covered by the capsule-type endoscope unit and loaded with a weighting factor, between the

instantaneous recording positions ( $x_m, x_n$ ) of the unit for recording the two individual images ( $m, n$ )

32. (New) A computer-assisted 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

recording images of surroundings of the endoscope unit;

transmitting image data of the recorded images, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device;

executing a pattern recognition algorithm for identifying substantially corresponding features of successive individual images of a recorded image sequence;  
and

carrying out an image processing procedure for the concatenation of individual images by superimposing the identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit, wherein

with each  $i$ -th recording, the position of the endoscope unit is detected and transmitted together with the image data to the reception and evaluation device and is digitally stored therein,  $i$  being a whole number greater than or equal to one, and

for concatenation of two individual images ( $m, n$ ), use is made of the path difference ( $\Delta x_{m,n} := x_n - x_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ( $x_m, x_n$ ) of the unit for recording the two individual images ( $m, n$ ).

33. (New) A computer-assisted 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

recording images of surroundings of the endoscope unit;

transmitting image data of the recorded images, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device;

executing a pattern recognition algorithm for identifying substantially corresponding features of successive individual images of a recorded image sequence; and

carrying out an image processing procedure for the concatenation of individual images by superimposing the identified, substantially corresponding image features in order thereby to produce a pseudo three-dimensional representation of the surroundings of the endoscope unit, wherein

for concatenation of two individual images ( $m, n$ ), use is made of the path difference ( $\Delta \underline{x}_{m,n} := \underline{x}_n - \underline{x}_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor, between the instantaneous recording positions ( $\underline{x}_m, \underline{x}_n$ ) of the unit for recording the two individual images ( $m, n$ ), and

instantaneous recording positions ( $\underline{x}_m, \underline{x}_n$ ) of the capsule-type endoscope unit are determined by evaluating X-ray pictures in which the endoscope unit is identifiable.

34. (New) A computer-assisted 3D imaging method for a wireless, capsule-type endoscope unit equipped with a video camera, comprising:

recording images of surroundings of the endoscope unit;

transmitting image data of the recorded images, in a wireless fashion, from the endoscope unit to at least one of a reception device and evaluation device;

executing a pattern recognition algorithm for identifying substantially  
corresponding features of successive individual images of a recorded image sequence;  
and

carrying out an image processing procedure for the concatenation of individual  
images by superimposing the identified, substantially corresponding image features in order  
thereby to produce a pseudo three-dimensional representation of the surroundings of the  
endoscope unit, wherein

for concatenation of two individual images ( $m, n$ ), use is made of the path difference  
( $\Delta x_{m,n} := x_n - x_m$ ), covered by the capsule-type endoscope unit and loaded with a weighting factor,  
between the instantaneous recording positions ( $x_m, x_n$ ) of the unit for recording the two individual  
images ( $m, n$ ), and

instantaneous recording positions ( $x_m, x_n$ ) of the capsule-type endoscope unit are  
determined by evaluating the signal transit times ( $T_m, T_n$ ) of the wireless image data transmission  
from the endoscope unit to the reception device.

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END OF CLAIM LISTING